Journal of the Society of Arts.

FRIDAY, SEPTEMBER 25, 1863.

THE LATE WM. TOOKE, PRESIDENT OF THE SOCIETY.

On Sunday last, the 20th instant, in the 86th year of his age, died William Tooke, Esq., F.R.S., the President of this Society. Mr. Tooke had been sixty-one years a member of the Society, having been elected in 1802. He long took a very active part in its management; and when, many years since, it was in a depressed state, he afforded it valuable assistance. On the death of His Royal Highness the Prince Consort, Mr. Tooke, then the oldest Vice-President, was elected to fill the vacancy thus created, and to the last he evinced a deep interest in all the proceedings of the Society.

Mr. Tooke was trained to the study of the law, and, having been admitted a solicitor, practised his profession for some years in London. Science, art, and literature had, however, greater attractions for him, and to their cultivation he devoted his energies. In 1804, he published anonymously an edition of Churchill's poetical works, which were re-published among the Aldine Poets, with the editor's name, in 1844. In 1855, he published a work entitled "The Monarchy of France, its Rise, Progress, and Fall;" having meanwhile given to the world several smaller productions. In conjunction with Lord Brougham, Dr. Birkbeck, Mr. Grote, and others, he took an active part in the establishment of the Society for the Diffusion of Useful Knowledge, and for a considerable period acted as its treasurer. For two years—namely, from 1835 to 1837, during the administration of Lord Melbourne—Mr. Tooke represented the borough of Truro in Parliament. He was born at St. Petersburg, and was the son of the Rev. William Tooke, an English divine and writer, who became chaplain to the factory of the Russian Company in that city, and was the author of a "Life of Catharine II.," "A View of the Russian Empire," and other works.

THE COMMERCE OF ABYSSINIA.

The following is the report by Vice-Consul Walker on the commerce of Abyssinia for the year 1863:—

Having recently returned from the coast of Abyssinia, after a residence there of many months, and thinking your lordship would be glad to be informed of the present state of commercial affairs in that neighbourhood, I have the honour to transmit the following report, in the hope that it may not be unacceptable to your lordship. Most of the commerce of this country, which would be considerable if there were no drawbacks thereto, it being so richly endowed by nature, is brought to Massowah, an island on the coast, which is merely a coral rock not more than a mile and a quarter in circumference, and which is about 200 yards from the main land. This island is governed by a Kaimakan, or governor, who is subject to the Pacha of Jeddah. It consists of his residence, which is almost the only tolerable house in the place—a ruinous fort or tower—a few warehouses of stone belonging to the Banians (who have transacted business with the Abyssinians for some years); a custom-house of stone in a most dilapidated state; a residence of stone belonging to the Jesuits, and a church which that fraternity are at present constructing; one or two ruinous mosques; a small stone house consisting of two miserable rooms which have been used lately as the consulate of her Britannic Majesty; two dilapidated houses used for similar purposes some years back by the French and Austrian governments; a dirty bazaar, and a numerous collection of miserable straw huts inhabited by the Arab and small Turkish population.

The whole of the export from the interior is brought down by porters, who are employed by the merchants twice a year—viz., in the end of February or commencement of March, when the rains are subsiding on the coast; and before the rains have set in in the interior another caravan, in the end of August, which leaves before the rain commences again on the coast. These caravans, when they arrive at a place called Ailat, which is situated on the plains of the low country, and about two days' journey from the coast, discharge their porters; their pay from Adona to Ailat is a dollar a head.

The country about Ailat consists of low sandy plains, which allow of their goods being safely conveyed on camels, mules, and oxen to the coast, when they are at once unloaded on a kind of stone quay which projects into the sea opposite the island, and immediately shipped across to Massowah, where they are detained in the custom-house till the proper tariff (8 per cent.) is levied on them.

We have no English merchant vessels at any time trading with Massowah. Two Indian or Banian vessels visit it during the year. No Turkish vessels go there at all, neither naval or merchantmen, but about thirty Arab bagalows are continually going backwards and forwards to Jeddah, Suez, Addeido, and Mocha, and occasionally to Aden, during the year. These boats are open, without a deck, with one or two latteen sails, some made of mat, some of canvas, and they seldom, if ever, lose sight of land, but are constantly hugging the shore, and when night sets in come to an anchor.

The articles of commerce which are brought from the interior of Abyssinia consist of small quantities of negro gold, ivory, musk, coffee, ghee (or rancid butter), hides, cotton, and a kind of coarse grain called dourah, much used by the natives for making their bread (there are two kinds, the red and white: the latter is the most expensive), honey and wax. The quantities of these articles brought by the two caravans during the year, as far as I was able to ascertain, consist of: Gold—great difficulty to ascertain the quantity that is brought from the interior, as a great deal is smuggled in to avoid the duty; ivory, 13,000 lbs.; musk, 560 lbs.; coffee, 10,000 lbs.; ghee, no tariff—constantly arriving from the frontier; hides—constantly arriving; cotton—small quantities brought to the coast, cultivated more for home consumption; corn, Dourah honey—always arriving in small quantities; great difficulty to ascertain the amount; wax—10,000 lbs.

The annual number of mules brought from the interior is about 1,200, their loads averaging from 250 lbs. to 280 lbs. each. Butter, honey, and hides in small quantities at all times in the year. Corn and dourah also. The value merely of goods arriving from the interior is given, not the weight. The whole of the gold is bought up by the Banians of Massowah, as is also the ivory. The gold is sold by the Maria Theresa dollar weight, viz., one dollar weight of gold is sold for 16 dollars. The ivory is sold at a dollar per rottoli, which is equivalent to our English pound. The whole of this article is also bought by the weight, either for specie or barter. The musk, which is brought down in small quantities on account of its scarcity, is consequently very dear, about 12 dollars the ounce. The price of coffee all depends on what quan-

tity there is in the market; when the large caravan arrives from the interior in the end of August, it averages from 8 to 9 rottoli the dollar. The price of ghee is about 3½ robeit the dollar. The robeit is equivalent to 1½ lbs. The price of common hides averages from ¾ of a dollar to a dollar a head. Spotted panther skins at a dollar and a dollar and a half each. Cotton, which is brought down in small quantities, is sold for 8 to 9 rottoli the dollar. Corn is sold by the kale, and generally runs from 9 to 15 kale the dollar. The price of dourah is the same as the corn. Honey and wax are sold at the following prices:—The honey is sold at 3½ robeit the dollar; the wax 1s., or 6 piastres, the cake, which is round, and about the size of a saucer.

There are about 15 to 20 Banian merchants on the island of Massowah, and they are in fact the only men who possess any money on the island. They have two vessels of their own, which are built similar to the bagalows, but far larger, which trade between the island and Bombay twice in the year. About 20,000 dollars yearly is expended in the country, money being scarce; the rest of the mercantile transactions are carried on by way of barter by the Banians, who seem to monopolise the whole of the trade.

Imports into Massowah.—These Indian merchants generally bring to the island quantities of red damask silks and coarse white cloths, called bafta, which the natives, residing on the coast, wear thrown around their bodies, (the Abyssinians spin their own togas); they also import moist sugar, sugar candy, printed cottons, coloured beads, and rice.

The dwellings of the three consuls, English, French, and Austrian, as also of the one or two Europeans, have always been situated on the main land three miles from the island, at a place called Montcouloo. The whole of this low sandy plain to the length of 60 or 70 miles is under the power of the Turks, who have a small garrison, to the amount of 100 men, chiefly Arabs, stationed at Arkeeko, which is about three miles by water from Massowah, and about ten across the plains. These men are under the command of the Alimanaga or colonel; there are now very few, if any, Turkish soldiers, almost the whole of them having been sent back to Jeddah.

The Nyab of Arkeeko, who in the time of Bruce's journey to Abyssinia was quite a powerful prince, is now nothing else than a mere puppet under the power of the Governor of Massowah, who orders him about as an ordinary vassal; his jurisdiction extends over the Arab and Bedouin Arab population around the coast to the extent of 30 to 40 miles, and he at times marches his men up on the high table land in the direction of Bogos, which lies on the frontiers of Abyssinia, and levies a tax on the inhabitants; this tax is levied either by persuasion or by force. The low country is inhabited by Arabs and Bedouin Arabs, who live in miserable huts; most of these tribes have large herds of cattle and flocks of sheep on which they subsist.

The rainy season commences on the coast at the latter end of October or commencement of November. The rainy season in the interior begins about the end of February, or commencement of March; and from the end of April to the commencement of September and October the River Teccazee, which divides the Province of Tigré from Abyssinia Proper, is so swollen by the rains that it is impossible to be forded. The whole of the lowlands during the summer months are completely devoid of vegetation, the stunted shrubs and grass being completely burned up; in fact, neither are there leaves on the trees, nor is there a blade of grass to be seen; all the cattle are driven away from the coast up to the high country; even the mules will not survive the heat. The temperature on an average during the hot summer months runs from 115 to 120 in the shade. The island and all the coast around can be compared to nothing but a vast furnace, where there is nothing to enliven the eye, and where it is impossible to find rest either by day or night. The Abyssinians from the interior cannot live in this climate for any length of time during the continuation of this heat, and to give an idea of the climate, a horse that I bought from an Abyssinian just arrived from the interior survived the change for two months, and then gradually sunk under it. In fact, the climate here, without any exaggeration, is not adapted for any European constitution.

The rainy season commences on the coast, as I have mentioned before, in the latter end of August or commencement of September, and then commences a frightful succession of fevers throughout the whole native population on the coast till the rainy season has completely set in. To give an idea of this, my wife and self, during the one year we were resident on the coast, had a succession of fevers, one after the other; my wife was attacked eight times, myself five. The weakening effect these fevers have upon the system takes a long time to eradicate its evil effects. After the rains have completely set in the grass commences to spring again, the leaves appear on the trees, and nature seems once more to revive after this lengthened and severe drought; but the herbage which springs up at first contains some poisonous matter till it has grown a sufficient height, and I have known from five to ten mules to die in a night in the village from the effects of this poisonous food. At no time of the year are there any vegetables to be had on the island, with the exception of a few tomatoes and onions, which are imported there, and Europeans are, in consequence, attacked by a running sore, which is somewhat similar to the dead-mark of Bagdad. Neither the French nor Austrian governments have had any representatives on the island for the last year or two, and during the year I was resident on the coast only one French man-of-war touched at the island.

The French, during the time I was resident at Massowah, purchased a place situated between Leila and the Babelmandel coast, by name Obokt, from the Dunkalie Chiec, for which they gave 10,000 dollars. The Chiec of the village, after receiving the money, disappeared, and his successor did not countenance the claim, or right of the French to purchase this site of land, nor of the Chiec to dispose of it, and the few huts that were erected by the French on that coast whilst occupied in surveying, after their departure were thrown into the sea by the natives. I need hardly mention that there is a good roadstead for ships, and also good water here, as most likely your lordship must have seen Captain Dayman's (of her Majesty's ship *Hornet*) account, who called there some years since to take soundings. But the place is devoid of vegetation, and if the natives were to turn restive, great difficulty would be found in obtaining food by the settlers, for at least some little time, until a certain amount of dread was thrown on the natives by troops that would have to be brought there for that purpose. No Romish priests, either French or Italian, are now tolerated in the interior of the country of Abyssinia; there are a few on the frontier, in the neighbourhood of Bogos, and also on the island of Massowah. There is very little trade done between Massowah and Suakin; most of the traders from Kartoum send their caravans to Suakin in lieu of Massowah; on one account owing to the distance being less and the route more convenient, and again because they are able to obtain a better market for their goods.

Before concluding, I may mention that the population of Massowah does not consist of more than one thousand, mostly Arabs, and a very few Turks. It is not fortified in any way; there are one or two rusty old cannons lying on the beach, but dangerous to be used; in fact, the last time they were brought into requisition, on the arrival of the Duke of Saxe-Coburg, they were found extremely deficient, and I may say almost useless, owing to the neglected state in which they had been allowed to remain for years. During the time of the large caravan, which is in the months of September and October, the Abyssinian merchants and their followers live on the island. They are all armed with lances and knives. They hate most fiercely their Mahomedan entertainers. The few troops

of the Kaimakan are quartered at Akeibro, on the main land. The Abyssinians feel that Massowah, the only port there is for their goods, is in the hands of the Infidels, and the Christian and Mahomedan hatred runs so high that the Abyssinians will not eat anything that has been killed by the Mahomedan, nor, *vice versa*, the Mahomedans the meat that has been killed by the Christians.

The slave trade is carried on in Abyssinia by the Mahomedan population, though the king does not sanction it himself, and droves of from 30 to 40 men, women, and children are brought down to the coast, and secreted in Arab villages round Massowah, and, under cover of night, put in small boats and dropped down by the tide to the larger crafts that are waiting a little distance below the island. They are then immediately put on board, and are taken across to Jeddah, Mocha, or Addeio, where they are kept till a fair price is obtained. In Massowah slaves are sold secretly, the Pacha pretending not to sanction it; in Jeddah, in the public market. As I have mentioned before, small quantities of cotton are brought down from the interior. I may observe, before concluding, that the country of Abyssinia is extremely endowed for the cultivation of this article, and large quantities most likely would be cultivated for exportation but for the uncertain and disturbed state the country is always in; and until some settled government be established, it would be useless to do anything with a view to the extension of the growth of this staple source of wealth.

Abyssinia, June 5th, 1863.

BRITISH ASSOCIATION, NEWCASTLE-ON-TYNE, 1863.

AUSTRIAN GUN COTTON.

A Committee, formed partly of members of the Mechanical Section, and partly of members of the Chemical Section of the Association, was appointed last year, to inquire into and report on Austrian Gun-Cotton.

Dr. GLADSTONE read the chemical portion of the report. Since the invention of gun-cotton by Prof. Schonbein, the thoughts of many have been directed to its application to warlike purposes. Many trials and experiments have been made, especially by the French; but such serious difficulties presented themselves that the idea seemed abandoned in every country but one, Austria. From time to time accounts reached England of its partial adoption in the Austrian service, though no explanation was afforded of the mode in which the difficulties had been overcome, or the extent to which the attempts had been successful. The Committee, however, have been put in possession of the fullest information from two sources—Prof. Abel, chemist to the War Department, and Baron W. von Lenk, Major-General in the Austrian Artillery, the inventor of the system. Prof. Abel, by permission of the authorities, communicated to the Committee the information given by the Austrian Government to our Government, and also the results of his own elaborate experiments. General von Lenk, on the invitation of the Committee, by permission of the Austrian Government, paid a visit to this country, to give every information in his power on the subject, and brought over drawings and samples from the Imperial factory. The following is a summary of the more important points:—As to the chemical nature of the material, Von Lenk's gun-cotton differs from the gun-cotton generally made, in its complete conversion into a uniform chemical compound. It is well-known to chemists that, when cotton is treated with mixtures of strong nitric and sulphuric acids, compounds may be obtained varying considerably in composition, though they all contain elements of the nitric acid and are all explosive. The most complete combination (or product of substitution) is that described by M. Hadon as $C_{36}\ H_{21}\ (9\ NO_4)\ O_{30}$, which is identical with that termed by the Austrian chemists Trinitrocellulose, $C_{12}\ H_7\ (3\ NO_4)\ O_{10}$. This is of no use whatever for the making of collodion; but it is Von Lenk's gun-cotton, and he secures its production by several precautions, of which the most important are the cleansing and perfect desiccation of the cotton as a preliminary to its immersion in the acids,—the employment of the strongest acids attainable in commerce,—the steeping of the cotton in a fresh strong mixture of the acids after its first immersion and consequent imperfect conversion into gun-cotton,—the continuance of this steeping for forty-eight hours. Equally necessary is the thorough purification of the gun-cotton so produced from every trace of free acid. This is secured exclusively by its being washed in a stream of water for several weeks. These prolonged processes are absolutely necessary. It seems mainly from the want of these precautions that the French were not successful. From the evidence before the Committee it appears that this nitro compound, when thoroughly free from acid, is not liable to some of the objections which have been urged against that compound usually experimented upon as gun-cotton. It seems to have a marked advantage in stability over all other forms of gun-cotton that have been proposed. It has been kept unaltered for fifteen years; it does not become ignited till raised to a temperature of 136° C. (277° Fahr.); it is but slightly hygroscopic, and when exploded in a confined space, is almost entirely free from ash. There is one part of the process not yet alluded to, and the value of which is more open to doubt—the treatment of the gun-cotton with a solution of the silicate of potash commonly called waterglass. Prof. Abel and the Austrian chemists think lightly of it; but Von Lenk considers that the amount of silica set free on the cotton by the carbonic acid of the atmosphere is really of service in retarding the combustion. He adds, that some of the gun-cotton made at the Imperial factory has not been silicated at all, and some imperfectly; but when the process has been thoroughly performed, he finds that the gun-cotton has increased permanently about 3 per cent. in weight. Much apprehension has been felt about the effect of the gases produced by the explosion of the gun-cotton upon those exposed to its action. It has been stated that both nitrous fumes and prussic acid are among those gases, and that the one would corrode the gun and the other poison the artilleryman. Now, though it is true that from some kinds of gun-cotton, or by some methods of decomposition, one or both of these gases may be produced, the results of the explosion of the Austrian gun-cotton without access of air are found by Karolys to contain neither of them, but to consist of nitrogen, carbonic acid, carbonic oxide, water, and a little hydrogen and light carburetted hydrogen. These are comparatively innocuous; and it is distinctly in evidence that, practically, the gun is less injured by repeated charges of gun-cotton than of gunpowder, and that the men in casemates suffer less from its fumes. It seems a disadvantage of this material, as compared with gunpowder, that it explodes at a temperature of 277° Fahr.; but against the greater liability to accidents from this cause may be set the almost impossibility of explosion during the process of manufacture, since the gun-cotton is always immersed in liquid, except in the final drying. Again, if it should be considered advisable at any time, it may be stored in water, and only dried in small quantities as required for use. The fact that gun-cotton is not injured by damp like gunpowder is, indeed, one of its recommendations, while a still more important chemical advantage which it possesses arises from its being perfectly resolved into gases on explosion, so that there is no smoke to obscure the sight of the soldier who is firing, or to point out his position to the enemy, and no residuum left in the gun, to be got rid of before another charge can be introduced.

Mr. J. SCOTT RUSSELL read the report on the mechanical portion of this question, by which it appears that greater effects are produced by gases generated from gun-cotton than by gases generated from gunpowder, and it was only after a long and careful examination that the Committee were able to reconcile this fact with the low

temperature at which the mechanical force is obtained. The great waste of force in gunpowder constitutes an important difference between it and gun-cotton, in which there is no waste. The waste in gunpowder is 68 per cent. of its own weight, and only 32 per cent. is useful. This 68 per cent. is not only waste in itself, but it wastes the power of the remaining 32 per cent. It wastes it mechanically, by using up a large portion of the mechanical force of the useful gases. The waste of gunpowder issues from the gun with much higher velocity than the projectile; and if it be remembered that in 100 lb. of useful gunpowder this is 68 lb., it will appear that 32 lb. of useful gunpowder gas is wasted in impelling a 68-lb. shot composed of the refuse of gunpowder itself. There is yet another peculiar feature of gun-cotton. It can be exploded in any quantity instantaneously. This was once considered a great fault; but it was only a fault when we were ignorant of the means to make that velocity anything we pleased. General von Lenk has discovered the means of giving gun-cotton any velocity of explosion that is required by merely the mechanical arrangements under which it is used. Gun-cotton in his hands has any speed of explosion, from 1 foot per second to 1 foot in $\frac{1}{1000}$ of a second, or to instantaneity. The instantaneous explosion of a large quantity of gun-cotton is made use of when it is required to produce destructive effects on the surrounding material. The slow combustion is made use of when it is required to produce manageable power, as in the case of gunnery. It is plain, therefore, that, if we can explode a large mass instantaneously, we get out of the gases so exploded the greatest possible power, because all the gas is generated before motion commences, and this is the condition of maximum effect. It is found that the condition necessary to produce instantaneous and complete explosion is the absolute perfection of closeness of the chamber containing the gun-cotton. The reason of it is, that the first ignited gases must penetrate the whole mass of the cotton, and this they do, and create a complete ignition throughout, only under pressure. This pressure need not be great. For example, a barrel of gun-cotton will produce little effect and very slow combustion when out of the barrel, but instantaneous and powerful explosion when shut up within it. On the other hand, if we desire gun-cotton to produce mechanical work, and not destruction of materials, we must provide for its slower combustion. It must be distributed and opened out mechanically, so as to occupy a larger space, and in this state it can be made to act even more slowly than gunpowder; and the exact limit for purposes of artillery General von Lenk has found by critical experiments. In general, it is found that the proportion of 11 lb. of gun-cotton, occupying 1 cubic foot of space, produces a greater force than gunpowder, of which from 50 to 60 lb. occupies the same space, and a force of the nature required for ordinary artillery. But each gun and each kind of projectile requires a certain density of cartridge. Practically, gun-cotton is most effective in guns when used as $\frac{1}{4}$ to $\frac{1}{3}$ weight of powder, and occupying a space of $1\frac{1}{10}$th of the length of the powder-cartridge. The mechanical structure of the cartridge is important as affecting its ignition. The cartridge is formed of a mechanical arrangement of spun cords, and the distribution of these, the place and manner of ignition, the form and proportion of the cartridge, all affect the time of complete ignition. It is by the complete mastery he has gained over all these minute points that General von Lenk is enabled to give to the action of gun-cotton on the projectile any law of force he pleases. Its cost of production is considerably less than that of gunpowder, the price of quantities which will produce equal effects being compared. Gun cotton is used for artillery in the form of a gun-cotton thread or spun yarn. In this simple form it will conduct combustion slowly in the open air, at a rate of not more than 1 foot per second. This thread is woven into a texture or circular web. These webs are made of various diameters, and it is out of these webs that common rifle cartridges are made, merely by cutting them into the proper lengths, and enclosing them in stiff cylinders of pasteboard, which form the cartridges. (In this shape its combustion in the open air takes place at a speed of 10 feet per second.) In these cylindrical webs it is also used to fill explosive shells, as it can be conveniently employed in this shape to pass in through the neck of the shell. Gun-cotton thread is spun into ropes in the usual way up to 2 inches diameter, hollow in the centre. This is the form used for blasting and mining purposes; it combines great density with speedy explosion. The gun cotton yarn is used directly to form cartridges for large guns by being wound round a bobbin so as to form a spindle like that used in spinning-mills. The bobbin is a hollow tube of paper or wood, the object of the wooden rod is to secure in all cases the necessary length of chamber in the gun required for the most effective explosion. The gun-cotton circular web is inclosed in close tubes of india-rubber cloth to form a match line, in which form it is most convenient, and travels with speed and certainty. In large quantities, for the explosion of mines, it is used in the form of rope, and in this form it is conveniently coiled in casks and stowed in boxes. As regards conveyance and storage of gun-cotton, it results from the foregoing facts that 1 lb. of gun-cotton produces an effect exceeding 3 lb. of gunpowder in artillery. This is a material advantage, whether it be carried by men, by horses, or by waggons. It may be placed in store, and preserved with great safety. The danger from explosion does not arise until it is confined. It may become damp and even perfectly wet without injury, and may be dried by mere exposure to the air. This is of great value in ships of war, and in case of fire, the magazine may be submerged without injury. As regards its practical use in artillery, it is easy to gather from the foregoing general facts how gun-cotton keeps the gun clean and requires less windage, and therefore performs much better in continuous firing. In gunpowder there is 68 per cent. of refuse, or the matter of fouling. In gun-cotton there is no residuum, and therefore no fouling. Experiments made by the Austrian Committee proved that 100 rounds could be fired with gun-cotton against 30 rounds of gunpowder. From the low temperature produced by gun-cotton the gun does not heat. Experiments showed that 100 rounds were fired with a 6-pounder in 34 minutes, and the gun was raised by gun-cotton to only 122° Fahrenheit, whilst 100 rounds with gunpowder took 100 minutes, and raised the temperature to such a degree that water was instantly evaporated. The firing with the gunpowder was therefore discontinued, but the rapid firing with the gun-cotton was continued up to 180 rounds without any inconvenience. The absence of fouling allows all the mechanism of a gun to have much more exactness than where allowance is made for fouling. The absence of smoke promotes rapid firing and exact aim. There are no poisonous gases, and the men suffer less inconvenience from firing in case-mates, under hatches, or in closed chambers. The fact of smaller recoil from a gun charged with gun-cotton is established by direct experiment; its value is $\frac{2}{3}$ of the recoil from gunpowder, projectile effect being equal. To understand this may not be easy. The waste of the solids of gunpowder accounts for one part of the saving, as in 100 lb. of gunpowder 68 lb. have to be projected in addition to the shot, and at a much higher speed. The remainder General von Lenk attributes to the different law of combustion. But the fact is established. The comparative advantages of gun-cotton and gunpowder for producing high velocities are shown in the following experiment with a Krupp's cast-steel gun, 6-pounder. With ordinary charge 30 oz. of powder produced 1,338 ft. per second. With charge of 13½ oz., gun-cotton produced 1,563 ft. The comparative advantages in shortness of gun are shown in the following experiments, 12-pounder:—

	Calibres.	Charge.	Velocity, feet per sec.
Cotton, length	10	15·9 oz.	1,426
Powder, ,,	13½	49 (normal powder charge)	1,400
Cotton, ,,	9	17	1,402

As to advantage in weight of gun, the fact of the recoil being less in the ratio of 2 : 3 enables a less weight of gun to be employed, as well as a shorter gun, without the disadvantage to practice arising from the lightness of gun. As regards wear of gun, bronze and cast-iron guns have been fired 1,000 rounds without in the least affecting the endurance of the gun. As regards its practical application to destructive explosions of shells, it appears that from a difference in the law of expansion, arising probably from the pressure of water in intensely-heated steam, there is an extraordinary difference of result, namely, that the same shell is exploded by the same volume of gas into more than double the number of pieces. This is to be accounted for by the greater velocity of explosion when the gun-cotton is confined very closely in very small spaces. It is also a peculiarity that the stronger the shell the smaller the fragments into which it is broken. As regards mining uses, the fact that the action of gun-cotton is violent and rapid in exact proportion to the resistance it encounters, tells us the secret of its far higher efficacy in mining than gunpowder. The stronger the rock, the less gun-cotton, comparatively with gunpowder, is necessary for the effect; so much so, that while gun-cotton is stronger than gunpowder as 3 to 1 in artillery, it is stronger in the proportion of 6·274 to 1 in a strong and solid rock, weight for weight. It is the hollow-rope form which is used for blasting. Its power of splitting up the material is regulated exactly as wished. As regards military and submarine explosion, it is a well-known fact that a bag of gunpowder nailed on the gates of a city will blow them open. In this case gun-cotton would fail. A bag of gun-cotton exploded in the same way is powerless. If one ounce of gunpowder is exploded in scales, the balance is thrown down; with an equal force of gun-cotton nothing happens. To blow up the gates of a city, a very few pounds of gun-cotton, carried in the hand of a single man, will be sufficient, only he must know its nature. In a bag it is harmless; exploded in a box it will shatter the gates to atoms. Against the palisades of a fortification, a small square box containing 25lb. merely flung down close to it, will open a passage for troops; in actual experience, on palisades a foot diameter and 8 feet high, piled in the ground, backed by a second row 8 inches diameter, a box of 25lb. cut a clean opening 9 feet wide. To this three times the weight of gunpowder produced no effect whatever, except to blacken the piles. Against bridges, a strong bridge of oak, 24 feet span, was shattered to atoms by a small box of 25lb. laid on its centre; the bridge was not broken, it was shivered. As to its effects under water, in the case of two tiers of piles, in water 13 feet deep, 10 inches apart, with stones between them, a barrel of 100lb. of gun-cotton, placed 3 feet from the face, and 8 feet under water, made a clean sweep through a radius of 15 feet, and raised the water 200 feet. In Venice, a barrel of 400lb. placed near a sloop in 10 feet of water, at 18 feet distance, threw it in atoms to a height of 400 feet. All experiments made by the Austrian Artillery Committee were conducted on a grand scale—36 batteries, six and twelve pounders (gun-cotton), having been constructed, and practised with that material. The reports of the Austrian Commissioners are all based on trials with ordnance, from six pounders to 48 pounders, smooth bore and rifled cannon. The trials with small fire-arms have been comparatively few, and are not reported on. The trials for blasting and mining purposes were also made on a large scale by the Imperial Engineers' Committee, and several reports have been printed on the subject.

Sir Wm. G. Armstrong said it was impossible to listen to the report which had been read without being very much impressed with the great promise there was of gun-cotton becoming a substitute for gunpowder; but at the same time there were certain peculiar anomalies about it which he certainly should like to have cleared up, and until they were, they could not feel that perfect confidence in the results that they wished to do. In the first place, with regard to the heat evolved, they were told that, with such a quantity of gun-cotton as would produce a given quantity of gas, a certain initial velocity was imparted to the projectile, and that the heating effect upon the gun was much less than when a similar velocity was produced by an equivalent quantity of gunpowder. The absence of heat in the gun implied an absence of heat in the gas. Where was the projectile force to come from, if there was no heat in the gas? He could not, for his part, conceive how it was possible of explanation. The next point that occurred to him was with regard to the recoil. It was stated that the recoil was very much less. That was ascribed to the absence of solid inert matter in the charge, which, in gun-cotton, was next to nothing. If the recoil was only two-thirds that of gunpowder, it would require, in order to account for that difference, a much larger quantity of solid matter than there really was in the case of gunpowder. The report stated that the use of gun-cotton enabled them to reduce the length of the gun. It was quite certain, however, that with a short gun they could not get an equal initial velocity as with a long gun. If the initial velocity were increased there was more danger of bursting the gun than with gunpowder. Because if they got any velocity, or an equal velocity with the shorter gun, it must be concluded that it was done by virtue of a greater initial pressure, and an earlier action upon the shot. That necessarily implied a greater strain upon the gun at the first explosion, and that would necessitate the employment of stronger guns. He should have expected a smaller velocity by a shorter gun, for the action of the gas was necessarily shorter than in a longer gun. The heat question, however, was to him the greatest puzzle of all. How they could have the propelling power without heat in the gas, and, if they heated the gas, how they escaped heating the gun, he could not understand.

Professor Pole said he was quite unable to give any explanation of the difference of recoil. If the shot left the gun with the same velocity as when fired with gunpowder, it was natural to suppose that there must be the same quantity of recoil.

Mr. Siemens having briefly spoken on the dynamical question involved in the matter, suggested that the greater heat imparted to the gun in the case of gunpowder might be owing to the greater amount of solid matter, which taking up the great heat of the gases under a pressure of some 400 atmospheres, imparted a portion of the same by radiation to the side of the gun, while in the case of gun-cotton gases only were produced, which could only impart heat to the gun by the slower process of conduction, and left a larger margin of heat to be developed in force by expansion.

Admiral Sir E. Belcher thought that the reason the gun was not heated by an explosion of gun-cotton might be because the gases had not time to heat the gun owing to the rapidity of the explosion, which was slower in the case of gunpowder; or that it might arise from the greater amount of fouling in the case of gunpowder.

Captain Maury said this report was something more than interesting, because it was so exceedingly suggestive, and it appeared to him that it afforded them an element of security by giving the preponderance on the side of defence. Ever since steam had been applied to purposes of naval warfare it had been considered a matter of very great doubt by many professional men how far ordinary steamers and men-of-war, where forts were to be passed at the mouth of a river, were capable of sustaining the fire of such forts and passing up the river. And to show that there was ample time for them to do so, they had only to recollect the fact of steamers having fought forts for several hours. In the Crimea and at Charleston the steamers had remained under fire for several hours—a much longer time than was necessary to enable them to pass the forts and go higher up the river into a place of safety where they could do damage to the enemy. Iron-clads had rendered this much more easy than it had previously been. If then their principal defences failed them at the

mouth of a river in this way, the question was whether they should not have recourse to mining for the destruction of the invading vessels? He himself had been engaged upon the subject. He found this difficulty in employing gunpowder, that in order to be sure of destroying the vessel as she passed in a given line by means of gunpowder, the magazines must be in actual contact, or very nearly in actual contact with the side of the vessel; otherwise the probability was that the vessel would not be destroyed. Last week they had the intelligence of a vessel having had a mine exploded under her on the James River. That magazine contained several thousands of pounds of powder. The vessel did not know that the mine was there; but the mine did not destroy the vessel. It merely threw up a column of water, which washed some of the men overboard. His own conclusion was, that to make sure of destroying a vessel after she had passed the forts, they must mine the channel in such a manner that the vessel must come in contact with one or other of the mines. It was found that wooden vessels to contain the powder would not do. They would not confine the powder long enough to produce a sufficient force. It was necessary to make them of stout boiler iron. It would not do to leave the magazines on the top of the water, and it would not do to put them at the bottom, for then there would be a cushion of water between the bottom of the ship to be destroyed and the magazine, which would protect the vessel. In short, they had to anchor them beneath the surface with short buoy-ropes, at a depth proportioned to the kind of vessel expected to come up. But when they made the magazine of boiler-iron they had to have buoys to float it so large that they were always in danger of being carried away by the vessels crossing the line of magazine. The plan was to place those magazines in a ring in such a position that the vessel in passing would have to come in contact with at least one and probably two of them. It was necessary to place those magazines of powder so that when you saw the vessel in that range you had only to bring the two poles of the galvanic battery together and make the explosion. There was, as already stated, a difficulty in using gunpowder. But since gun-cotton had the remarkable effect of destroying a vessel—he did not know her strength—at a distance of 18 feet, and that not vertically, but laterally, the question arose whether they might not fortify and protect those channel ways by placing a ring of gun-cotton magazines along the bottom; but, at any rate, if that was not necessary, they could float them at any depth, and out of reach of the vessels generally using the channel. That appeared to him to be one of the most important uses of gun-cotton, and it was one which would give safety to cities which were some distance from the mouths of navigable rivers. He trusted that in the event of the Committee continuing their labours, they would address their attention to this important point.

Admiral Sir E. BELCHER stated that the explosion of gunpowder under water was once done under one of his own vessels to clear away ice. He placed it upon the ground, thinking that its explosion would blow the ice clear of her bows without touching the vessel. There was, however, sufficient water to form a cushion, and when the explosion took place it only produced a great wave upon which the vessel rose.

Professor POLE said what they wanted was something to show the varying pressure of the gases in the gun; in fact, an indicator diagram.

Mr. J. SCOTT RUSSELL set himself to clear away the many difficulties which attended this very difficult subject. How was it that in gunpowder and in gun-cotton where there were equal quantities of gas put in, the gas in the case of gunpowder was raised to an enormously high temperature, and came out at an enormously high pressure, showing that they had gas enormously expanded by heat; whereas in the case of gun-cotton the gas came out quite cool, so that you might put your hand upon it, and the gun itself was quite cool? He (Mr. Russell) had a theory. Steam was a gas, and steam expanded just by the same laws as other gases did. A great deal of the gas of gun-cotton happened to be steam. Let them conceive 100 lb. of gun-cotton shut up in a chamber that just held it. They had got there all the gases that had been spoken of, but they had also got about 25 lb. of solid water—about one-third of a cubic foot of water—in that chamber. What did they do with it? They put fuel, they put fire to it. They heated the whole remaining pounds of patent fuel. If, then, they considered the gun-cotton gun as the steam-gun, they got rid of two difficulties. They would have, first, the enormous elasticity of steam; and secondly, they would get the coolness of it. They all knew that if they put their hand to expanded high pressure steam, it had swallowed up all the heat and came out quite cool. He believed that the gun-cotton gun was neither more nor less than Perkins's old steam-gun with only this difference, that you bottled up the fuel and water, and let them fight it out with each other. They did their work and came out quite cool. He hoped, however, that it was understood that he did not dogmatize. He put all he had said with a note of interrogation upon it.

Professor TYNDALL said he thought that a note of interrogation ought to be put to what Mr. Russell had said.

Capt. GALTON, presuming there were yet many points that required further investigation, moved that a proposal be submitted to the Committee of Recommendations, that the Committee be requested to continue their labours for another year. He was sure the War Office would be glad to assist as much in the inquiry as they had hitherto done.

The subject was considered of so much importance that the British Association, though it has re-appointed the Joint-Committee to continue its inquiries, has passed a resolution to urge on the Government the appointment of a Commission by means of which a more complete investigation, and such as the subject unquestionably deserves, may be made than the means at the disposal of the Association will admit of.

NEW METHOD OF WORKING RAILWAYS BY STATIONARY ENGINES.

The following paper, by Messrs. R. and W. Hawthorn, was read in Section G:—

The paper brought before this section to-day is a description of a method of working a certain class of railways by means of ropes from stationary engines.

A system of working railways by fixed engines and ropes has long been in use on the colliery railways around Newcastle-upon-Tyne, as well as in other districts, and a plan for the same was made the subject of a patent by Mr. Benjamin Thompson, then of Ayton Cottage, in the county of Durham, and was introduced on one or two colliery railways. It consisted of a succession of fixed engines at certain intervals from one end of the line to the other, each engine being employed to work a portion of the railway in the following manner.

The engine gave motion to two rope rolls, and the rope from one of those rolls was attached to one end, and the rope from the other roll was attached to the other end of the train. Whilst one of the rope rolls was disengaged from the engine, and allowed to run loose, the other was in gear, and the rope from it was passed along the line, and round a loop sheave, then brought back and attached to the train. The engine being put in motion the train was dragged to the furthest end of the section worked by that engine, at the same time unwinding the rope from the loose roll, and taking it with it to be afterwards employed to drag back the returning train. This was continued throughout the line, each successive engine taking up the train and carrying it over a section of the line. This method was not a satisfactory one for the conveyance of passengers, as the rider or guide in charge had not sufficient control over the movements of the train, and there is an objection to the carriages being attached directly to

the rope, and at such a distance from the motive power. Ropes have been, and are yet, applied in other ways, for instance, on gravitating or descending planes, down which a loaded train passes, having the rope attached to the after-end, round a sheave at the top of the incline, and thence down to the ascending train, and thus the descending loaded train draws up the ascending light train; or, where the load has to ascend, a fixed engine is employed to draw it up, and the descending train takes the rope down with it. Ropes are also applied in a variety of ways to the working of incline planes on passenger railways. Thus there is nothing new in the use of stationary engines and ropes for working railway traffic. It will be observed that in all the cases referred to the rope is attached directly to the carriages.

In the proposed plan now offered to the notice of members of the Association the means of communicating motion to the train give greater security, as well as the advantage of avoiding the necessity of attaching a train to the end of a rope, thus ensuring to the guard as complete control over the movements of the train as he now has in the employment of the locomotive engine. In the new system it may be stated without exaggeration that the rope drives the locomotive wheels, and each carriage carries its own railway.

It is proposed with the ordinary construction and gauge of railway to place in the intermediate space between a double line of rails a series of double grooved sheaves fixed in spindles or axles which pass across under the rails extending a little over the centre of each line; a plain wheel or roller is fixed upon each end of these axles, by which the motion is communicated to the train from a stationary engine or engines placed at a convenient point of the line —by means of an endless wire or rope passing alternately over and under the grooved sheaves to the extremity of a section of the line where it is taken round a large loop sheave, and returned to the engine now passing over each sheave which it before passed under, and *vice versâ*, the double groove providing for the rope crossing itself without contact.

Having traversed twice along the line of sheaves the rope goes again on to the large winding sheave of the engine, on which a sufficient number of turns are taken to ensure the requisite friction.

From this arrangement of the rope on the sheaves, it will be seen that every alternate sheave runs in the same direction, and every intermediate sheave in the contrary direction; and this motion is communicated to the traction wheels or rollers before mentioned.

It is proposed to construct the carriages for passenger-lines on the principle of those used in America and on the Canadian railways, of a length of from 60 to 75 feet, and supported on bogies, and capable of seating from 120 to 160 passengers, each carriage to be fitted with traction bars—these bars extending over two or more alternate traction rollers—and to be furnished with the ordinary flanged wheels for running on the rails. The traction bars, of which there are two, are placed side by side, at such a distance from each other as may be necessary to meet the requirements of the line; and these traction bars are worked either in connection with or independent of each other by a suitable arrangement of levers or other gearing, by which either of the bars can be raised or depressed, thereby bringing a portion of the weight of the carriages upon the traction wheels or rollers, thus giving motion to the train of carriages in either direction. Or both these bars can be raised out of contact with the traction wheels or rollers, and the train left free from all tractive force.

The traction bars will be nearly the full length of the carriage, and the traction rollers will be placed about 18 feet apart, or at the rate of 293 per mile.

The carriage made in this way is adapted for running with either end first, being provided at each end with a platform on which the driver stands to work the traction bars; and it is considered that for ordinary traffic one carriage will be sufficient to form a train, but two or more may be attached to each other, or the number of trains of a single carriage each may be increased to meet the requirements of the traffic.

The motion of the train can be quickly and certainly retarded or stopped by raising one bar and depressing the other, in the manner of a brake, thereby reversing the direction of the driving motion.

A separate or independent traction carriage may be used, fitted with the traction bars and gear; but it is considered that such an arrangement would, in most cases, only be adding a useless and unnecessary weight to the useful portion of the train.

The present line of underground railway through London, from Paddington to Farringdon-street, is favourable to the use of the locomotive engine, where so much of the surface of the ground under which it passes is unoccupied by buildings, and readily admits of a good deal of open cutting and ventilation at the stations, which cannot be the case where the railway passes under the densely-populated parts of a city, as those projected in London must do. In such cases it will be necessary to provide for working in a continuous tunnel of perhaps three or four miles in length, in which the steam and smoke of locomotive engines would prove obnoxious to a much greater extent than is experienced on the present line, which is only partially an underground railway. As there does not appear to be any means of remedying these evils, except at a very extravagant cost, it is believed that the new system may be introduced with advantage in such cases as are above referred to, viz., railways passing under large towns or in situations where opportunities do not occur of having openings to the surface.

The maintenance of the engines will be considerably less than with locomotives, to balance the expense of keeping in working order the sheaves, ropes, &c., which will cost more than an ordinary line.

Both calculation and experiment on the adhesion required to propel a train remove any reasonable doubt of being able, by the new system, to obtain sufficient tractive force by the tractive bars and rollers, and it is evidently quite feasible to increase this tractive force if required.

With a locomotive a train of 15 or 20 carriages has to be drawn by an intense pressure on six or eight points, and it is this which adds such a heavy item to the cost of railway maintenance. This disadvantage will be, to a great extent, remedied by the proposed system, the tractive force being more distributed, and consequently the wear and tear diminished. Finally, if such a system as the one proposed can be introduced free from the objections that have hitherto been considered inseparable from the use of ropes, it will greatly facilitate the construction and extension of underground railways without their present drawbacks.

PALSER'S IMPROVED MACHINERY FOR PAPER-MAKING AND RECOVERING THE ALKALI.

The object of this invention is to reduce straw or similar material to pulp in an economical and expeditious manner by means of two cylindrical boilers rotating above a reverberatory furnace. Above these boilers are vats, brought into communication with the boilers by arrangement of suitable piping—the boilers for receiving the material to be operated upon, and the vats the liquor which has been used in the treatment of the fibrous materials. The bottoms of the vats are pierced with holes (capable of being closed as required), through which the liquid is allowed to drip and flow over the rotary boilers. Within the wall separating the two boilers is an arrangement for warming air and water respectively, for filling the boiler and accelerating the evaporation in the vats. The pipes in the boiler for discharging the liquor are separated from the stock in the boiler by perforated partitions, and can neither

be broken nor bent by the pressure of the revolving stuff, or closed by solid matters accidentally forced into them.

In operating upon straw especially it is first cut into suitable lengths, winnowed to cleanse it from dirt, and crushed between rollers to make it ready for boiling. The boiler is then filled with the material, the necessary quantity of liquid run into it, and fire-heat and steam diverted to it from the adjacent boiler until the temperature and pressure are equal in both. This operation is important as the means of raising the temperature of the one boiler, while the cooling of the other is facilitated and the alkaline-charged steam made use of. The steam remaining in the boiler to be cooled is caused to force up the exhausted liquor into the vat above the boiler, which is afterwards discharged upon the surface of the boiler below, when a rapid evaporation of the liquid is produced, and its change into a viscous state effected. The material in the boiler is then washed, by being placed in a tub with a false bottom, by letting in water below which an increased degree of agitation is obtained, and consequently more effectual washing. The stuff is afterwards treated in the usual way.

SALT AS A MANURE.

Mr. Fras. Mewburn, Larchfield, Darlington, has addresed a circular to the farmers in the county of Durham, and in Cleveland, informing them that the Liverpool Chamber of Commerce employed Dr. Phipson to report on salt as a manure, and the following were his conclusions:—"1. That without a due proportion of salt, plants cannot attain their proper degree of perfection; and this applies especially to colza, turnips, swedes, beet, spinach, wheat, oats, maize, and other grasses. 2. That salt is an essential constituent of plants as well as animals. 3. That the soil is constantly losing, by cultivation, a great amount of salt, taken away by the crops. 4. That none of the manures at present used (except a very few of the best superphosphates) contain any salt; even guano shows only four-tenths per cent. 5. That it is necessary to add salt at regular intervals to the soil, in some shape or other, if we wish to derive the greatest possible benefit by our crops. Mr. Mewburn believes that salt will be furnished in great abundance and cheap in the country of Durham and in Cleveland, and expresses a hope that the farmers in those districts will test the doctor's "conclusions" by extensively using salt in their tillage tand.

Home Correspondence.

HOMES OF CELEBRATED MEN, POSITIONS OF IMPORTANT ABBEYS, CASTLES, BATTLE-FIELDS, &c.

SIR,—It has already been stated to Mr. Ewart, that it has been proposed that the position of Sir Isaac Newton's home, where he lived and died, in Kensington, in 1727, might be marked on the ordnance maps of that part.* And in reference to Mr. Ewart's comprehensive idea of marking the homes of eminent men, the use of the ordnance maps was not only extended for that purpose, but to find the positions of abbeys, castles, battlefields, &c., &c.

What was suggested to Mr. Ewart was, that tracing cloth, of the size of ordnance sheets, should be divided into a number of squares, and that alphabetical explanatory indexes of reference should be prepared to point out in what part within any square the position sought for could be found.

I have now an ordnance sheet, 23 by 29 inches nearly, before me. This of course cannot be divided into squares, but it may be into parallelograms of the same proportion, and if ordnance sheets were thus divided by faint, or, better still, coloured lines, that would give great facility for identifying nearly the position of any place sought for.

Then if, of the size of one of these divisions, a transparent glass, mounted, and divided into any convenient number of smaller divisions, be placed thereon, the position of any place sought for could instantaneously be more closely approximated, if not identically found, by the index properly prepared.

Tourists would find such guides of vast service in their botanical, geological, or other research for matter worthy of their attention or investigation. Of course with transparent cloth, divided as the sheets of ordnance maps, and placed thereon, the glass guide could with equal facility be used.

These suggestions for extending the use of ordnance maps for education are submitted for consideration and further improvement.

I am, &c.,
JOSEPH JOPLING.

6, Vassall-terrace, Kensington, W.

* See the *Leisure Hour*, 13th September, 1862, page 584.

Proceedings of Institutions.

GLASGOW MECHANICS' INSTITUTION.—The fortieth annual report says, that although the past year has been one of great depression of trade, the classes as a whole have been well attended. In their report of last year, the directors intimated that day classes were to be commenced forthwith; and they feel gratified in being able to state that these have been most successful. The course of lectures on chemistry was this session entirely occupied with the systematic study of organic chemistry, including the acids, alkaloids, radicals, alcohols, hydro-carbons, colouring matters, &c. Several lectures were devoted to the elucidation of the principles of chemistry as applicable specially to the organic department of the science—the new notation was illustrated, and the modern classification of organic compounds was explained. Dr. Wallace, the teacher, expresses himself highly pleased with the strict attention of the class, and with the result of the Examination. In the Natural Philosophy Class, principally with the view of preparing students for the Society of Arts Examination, the subjects taken up by the lecturer (Dr. Johnston) were the principles of electricity, magnetism, and heat. The junior classes in the music department have made marked progress; at the end of the session they are, generally speaking, qualified to sing simple music at first sight. Commencing with the rudiments of the science, they proceeded through a course of the theory, qualifying them for the study of harmony and thorough bass. The advanced class had for text-books a work on thorough bass, by Mr. John Hullah, and a small work on the theory and practice of harmony, written expressly for advanced classes, in the study of which a creditable amount of knowledge has been acquired. Of the conduct and attendance of both classes, the teacher (Mr. Barr) speaks in the highest terms. The Animal Physiology Class was conducted in a similar method to that of last year. By means of oral examinations the lecturer (Dr. Leishman) took an opportunity, from time to time, of ascertaining whether the subject was understood, and always with satisfactory results. The Elocution Class has been made thoroughly conversant with the rules of oratorical speaking, and although (from a desire to lay a good and solid foundation) the class did not arrive at the delivery of set speeches and orations, yet there were very few (out of 80 or 90 students composing the class) who were not reported by the teacher as able to read with perfect rhetorical propriety any book which might be put before them. The Mechanical Drawing Class, under Mr. Peter Stewart, consisting principally of engineers and persons connected with other mechanical professions, has had a

very prosperous session; the number of tickets sold being considerably in excess of last year. The lessons, as usual, comprised plans, sections, and details of a great variety of machinery, arranged so as to suit the capacity of the students and the particular branches of the profession they are connected with. In the early part of the session the subjects under consideration were — geometry in its practical applications; the various curves used in the arts; projections and descriptive geometry. In the latter part of the session the more important details of the steam-engine and applied mechanics were considered, and illustrated largely by diagrams and models from the museum of the Institution. Mr. Stewart also, on two extra evenings, gave an account of what he saw in the machinery and engineering departments of the International Exhibition. The junior students in the Drawing, Painting, and Architecture Class, were, as formerly, instructed by Mr. A. D. Robertson, in the drawing of simple elementary forms, and progressively introduced to more advanced and complex figures requiring a knowledge of the general principles of perspective, which was carefully imparted to them. The advanced students were separated into classes for the study of ornament, figure, flowers, landscape, and architecture, each one making choice of that division of study which seemed most conducive to his future prospects. In the Architectural Class, the students went through a short course of practical geometry, in which they obtained a knowledge of the construction of scales, and, while studying the best examples of classic and gothic periods, had the varied features of each style fully explained to them, as well as the different modes of projection employed in perspective and working drawings. In the English Grammar, Composition, and Literature Class (teacher, Mr. R. B. Smith), the course of study during the session has embraced systematic instruction in English grammar, composition, language, and literature. The text books used were—" Angus's Handbook of the English Tongue," and " Milton's Paradise Lost," books I. to IV. The former work formed the basis of the lessons in grammar, composition, and language; the latter was read, the classical and other references explained, the style examined, and many portions of it parsed, analysed, and paraphrased. Home exercises were prescribed in letter, theme, and essay writing. In literature the master gave short occasional instructions on the English authors and their works. In the French class under Monsieur Dutoit, grammar, theoretical and practical, readings in prose and verse, idioms, conversation and composition, form the regular course. The German classes of the past session, under Herr Rehbann, consisted of the junior and advanced classes, which were respectively engaged with Dr. Ahn's grammar, Ollendorf's more advanced exercises, and Schiller's Wallenstein, varied by conversation and composition. The students amount to 66. During the present session the studies of the Spanish classes, under Mr. T. Henderson, have embraced the method of Ollendorf, and commercial and literary correspondence, and conversation. In the Latin and Greek Class, under Mr. Alexander Ramsay, A.M., the object of most of the students has been to prepare for the University, and their studies have been directed accordingly. The success of the classes is fully shown by the number of enrolments, which have this session reached to upwards of 110, being considerably more than double those of last year. In the Arithmetic and Mathematics Class, under Mr. H. M. Ashcroft, the business of the session was commenced with a series of lessons on logic, with a view to facilitate the study of geometry. The students were next made acquainted with such algebraical processes and symbols as enabled them to understand and appreciate the scientific investigations of the principles of arithmetic. During the course of the session, the higher rules of arithmetic were studied, also elementary algebra. The first three books of Euclid, and the fifth and sixth books, were carefully gone over. Dr. Thomson's tract on trigonometry was read, and the nature and use of logarithms learned. The Writing, Arithmetic, and Book-keeping Class was carried on by Mr. John Macgregor. The Mutual Instruction Class continues to hold an important position in connection with the Institution. There are 65 names on the roll, with an average weekly attendance during the session of 40. The business of the association consists, principally, in the reading of essays and discussions on subjects of general interest. The MS. Magazine, which was commenced in April, 1862, is now issued fortnightly. The course of lectures on geology has been resumed, and is progressing satisfactorily, under the superintendence of Mr. Thomas Struthers. There is to be a course of lectures on botany, conducted by Mr. Keddie. The library now consists of above 6,700 volumes, a large addition of valuable works in the various departments of literature, science, and art, having been made during the past year. Besides the students attending the classes, the library is open to the public at the annual charge of 5s. Considerable additions have recently been made to the museum, the accommodation of which is now largely extended. The " Middle Class School," established under the auspices of the directors, was open on the 1st August last year. Being a new undertaking in an untried field, some fears could not but be entertained respecting it; and, at most, great success was not looked for during the first year. It is, therefore, a matter of great pleasure to be able to report that the school has already met with marked prosperity: the number of pupils that have been enrolled in the various classes during the first session is close upon 200. The school is conducted on the same principles as the higher academies, and affords to the middle classes all the advantages of these institutions at lower fees. The several departments are under the care of separate masters, of tried efficiency. The girls and boys are, except in the junior department, taught in separate classes, and in the higher English classes at different hours. All the classes enjoy the instructions of the head-masters of the departments daily; and, in the case of the higher classes, each class is under the care of a separate master during the whole of its time in school. In the English department, which consists of three divisions—junior, senior girls, and senior boys—there are classes of all stages of advancement, from the alphabet to an advanced class for young men about to enter business, and a senior class for young girls for the study of grammar, composition, syntactical and logical analysis, and literature. In these classes 154 pupils have been enrolled. In the commercial department, there are classes at different stages in writing and arithmetic, and some pupils studying book-keeping, mensuration, algebra, and geometry. 111 pupils have been enrolled in this department. In the Latin class, seven pupils have been entered; in the French, sixteen; in the pianoforte, twenty-one; and in needlework, seventeen. Some pupils attended only one class, but three-fourths of the whole number attended two; many were members of three, and some of four or five. Altogether 191 scholars have been entered on the roll, including nearly an equal proportion of boys and misses. The abstract of income and expenditure shows that the receipts have been £1,332 19s. 8½d. and that there is a balance of upwards of £200 in hand.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, September* 18*th*, 1863.]

Dated 8th May, 1863.

1158. C. F. Bielefeld, Gower-street—Imp. in the manufacture of sheets, slabs, and other articles where fibrous materials are employed.

Dated 14th August, 1863.

2007. A. E. Brae, Leeds—Improved means of conducting electric currents through railway trains, and of actuating signals or alarums therein.

Dated 15th August, 1863.

2023. E. Scott, Manchester—Certain imp. in apparatus for governing or regulating the speed of engines. (A com.)

Dated 20th August, 1863.

2065. G. Spencer, 6, Cannon-street-west—Improved solutions to be used in the manufacture of paints and the preservation of wood, stone, and metallic surfaces, and in the preservation and waterproofing of fibrous materials generally, and for other purposes. (A com.)

2068. W. Hamilton, 45, Ship-street, Brighton—Imp. in the manufacture of spring mattresses.

Dated 21st August, 1863.

2076. T. F. Cashin, Sheffield—Improved means of communication between the passengers, guard, and driver of a railway train in motion.

Dated 25th August, 1863.

2101. W. E. Gedge, 11, Wellington-street, Strand—Imp. in machinery or apparatus to be used in the manufacture of candles. (A com.)

Dated 27th August, 1863.

2115. T. Bourne, New York, U.S.—Improved method of storing and holding petroleum and other oils, naphtha, and other products of distillation containing essential oils. (A com.)

2116. F. Pragst, Manchester—Certain imp. in steam engines, and in the mode of utilizing steam.

2117. J. Clark, Glasgow—Certain imp. in break blocks for railway and other carriages, and in the means of applying the same.

Dated 28th August, 1863.

2123. R. Bell, Glasgow—Imp. in measuring apparatus for looms.

2125. E. Vickers, Sheffield—Imp. in the manufacture of steel.

2129. C. Harratt, Hornsey-lane, Highgate—Imp. in apparatus for tilling land.

Dated 29th August, 1863.

2131. H. C. Pennell, Weybridge, Surrey—Imp. in the construction of skates.

2132. H. W. Putnam, New York, U.S.—Improved machine for wringing clothes.

2133. G. Lowry, Salford—Imp. in and applicable to cotton gins.

2135. W. Tingey, Manchester—Imp. in printing carpets, piled fabrics, druggets, and other similar articles.

2136. T. Williams, Manchester—Imp. in machinery or apparatus for steaming and opening cotton and other fibrous materials.

2139. A. Agnew, Welshpool, Montgomeryshire—Imp. in breech-loading fire arms.

2141. W. Weldon, 3, Falcon-court, Fleet-street—Imp. in apparatus for aerial navigation.

2143. J. Dodge, Manchester—Imp. in machinery or apparatus for grinding and polishing metallic articles.

Dated 31st August, 1863.

2147. F. A. Braendlin, Birmingham—Imp. in breech-loading fire-arms.

2149. B. L. Burnett, Teignmouth—Improved arrangements for removing the fuel from stoves or grates, and for facilitating the extinguishing of the fires used therein.

2153. J. Miles, Hastings—Imp. in traps for catching rats and mice, rabbits, and other animals and birds.

2155. M. J. Roberts, Brecon—Imp. in the arrangement or fitting of axles for railway and other carriages.

Dated 1st September, 1863.

2156. J. Snider, jun., Dorset-street—Imp. in breech-loading and other ordnance, part of which is applicable to the utilising of old smooth bore cannon, and in projectiles to be used therewith.

2157. C. Shorrock and W. Shorrock, Over Darwen, Lancashire—Certain imp. in looms for weaving.

2158. G. Russell, Glasgow—Imp. in apparatus for cooking, and for obtaining fresh water for use on shipboard and otherwise.

2159. W. Clark, 53, Chancery lane—Imp. in hydraulic apparatus. (A com.)

2163. T. Erich, 77, Newgate-street—Imp. in machinery for pressing peat. (A com.)

Dated 3rd September, 1863.

2176. W. Boulton and J. Worthington, Burslem, Staffordshire—An improved method of making and inlaying encaustic tiles or other plastic articles and substances.

2178. W. Jolliffe, T. Jolliffe, W. Graham, and H. Taylor, Liverpool—Imp. applicable to paddle and other propelling wheels for navigable vessels.

2182. J. Loebl and I. Pick, Scott's-yard, Bush-lane—Imp. in fastening gloves.

Dated 4th September, 1863.

2186. T. Fisher, 7, Remington-street, City-road—Imp. in spring balances where spiral springs are used.

Dated 5th September, 1863.

2188. G. Hargreaves, Shipley, Bradford—Imp. in steam boilers.

2190. W. Norton, Holley Bank, near Arva, Cavan—Imp. in laying and supporting submarine telegraph cables.

2194. R. Batt, Waterhouse Mill, Milnthorpe, Westmorland—Imp. in paper making machinery.

2196. G. B. Rennie, Holland-street, Blackfriars—Imp. in the construction of floating docks and pontoons, and the means of cleaning, painting, or repairing them.

Dated 7th September, 1863.

2200. H. Twelvetrees, Bromley, Middlesex—Imp. in portable mangling and wringing apparatus.

2202. S. Gerish, 60, Shoe-lane, Holborn, and J. Weston, 80, White-cross-street, St. Luke's—Imp. in machinery for morticing, drilling, dovetailing, and cutting wood, and in tools to be used for morticing.

Dated 8th September, 1863.

2204. J. H. Cutler, Birmingham—A new or improved dress fastening, which said fastening is also applicable to the fastening of bands and belts and to other like purposes.

2206. W. A. Wilson and J. Smith, Liverpool—Imp. in furnace fire-grates.

2210. W. Hewitt, Bristol—An improved rudder, and means of working the same.

Dated 9th September, 1863.

2216. T. Naden, jun., Birmingham—Imp. in raising the covers or lids of hot water jugs, tea-pots, coffee pots, and other vessels.

2220. E. T. Hughes, 123, Chancery-lane—Imp. in the manufacture of chenille, and in the machinery or apparatus employed therein. (A com.)

PATENTS SEALED.

[*From Gazette, September 18th*, 1863.]

18th September.

735. E. Lever.
736. H. Wilde.
740. C. Webster and W. Forgie.
745. J. Nield and T. A. Nield.
746. R. A. Brooman.
750. C. Pryse and D. Kirkwood.
752. F. de Wyldé.
754. F. Roberts and A. Roberts.
756. G. A. Biddell.
757. E. Hartley, J. Clegg, T. Mellodew, and J. Mellodew.
758. J. M. Hetherington.
764. W. Johnston.
769. J. Reilly and W. Martin.
780. G. Stuart.
781. C. Monson.
782. R. Armitage and C. Senior.
785. R. A. Brooman.
787. L. Christofleau.
789. G. Cowdery.
792. W. Johnson.
801. J. Grantham.
802. W. M. Morgan.
804. J. Taylor, jun.
811. J. Leeming and R. S. Markindale.
816. J. Musgrave.
818. R. Mushet.
821. W. E. Newton.
839. W. Clark.
848. D. S. Sutherland.
884. J. Mosheimer.
905. G. Colomb.
952. A. V. Newton.
1010. W. E. Newton.
1040. A. Legras.
1064. W. Clark.
1223. W. Clark.
1262. J. Coignard.
1339. C. E. Laederich.
1616. W. Bradshaw and J. Bradshaw.
1619. G. Davies.
1693. W. Basford.
1788. A. Montleart and W. Tent.
1826. J. E. Vanner.
1844. G. Davies.
1862. W. Tranter.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, September 22nd*, 1863.]

14th September.

2243. J. Horsey.
2257. G. F. Smith.

15th September.

2249. S. Barnwell and A. Rollason.
2282. T. Greenwood.
2298. R. Mushet.
2326. J. Haworth.

16th September.

2260. W. E. Newton.
2262. W. E. Newton.
2295. T. Westhorp.

17th September.

2264. H. Stead and H. Gledhill.
2271. G. Owen.

18th September.

2290. V. H. Laurent.
2292. J. Cash and J. Cash, jun.
2306. H. E. Skinner and W. H. Miller.
2365. R. Mushet.

PATENT ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[*From Gazette, September 22nd*, 1863.]

14th September.

2169. S. Chodzko.
2202. W. Young.
2294. J. Holman.

16th September.

2251. J. J. Russell & J. B. Howell.

LIST OF DESIGNS OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietor's Name.	Address.
4575	Sept. 14.	Child's Normal	Charles Smith Mary Shepherd	34, Union-street, Borough, E.C. 35, Surrey-street, Croydon, E.
4578	" "	Button Gauge	George Philip Hill, of the firm of Sturgeon and Co.	121, Wood-street, Cheapside.